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SUMMARY OF

STATE-OF-THE-ART METHODOLOGY

AIR FORCE STRUCTURES, STRUCTURAL DYNAMICS

AND MATERIALS WORKSHOP

PRESENTED OCTOBER 3, 1980

AIR FORCE WRIGHT AERONAUTICAL LABORATORY

WRIGHT PATTERSON AIR FORCE BASE

DAYTON, OHIO

FOREWORD

This report is submitted as an addendum to CISM-AFOSR-80-1

dated September 1980, STATE-OF-THE-ARTS METHODOLOGY AIR FORCE

STRUCTURES, STRUCTURAL DYNAMICS, AND MATERIALS WORKSHOP INTERIM

REPORT. Through submission of this addendum, the previously

submitted report, CISM-AFOSR-80-1, is now considered as a final

report. This completes contract requirements associated with

post conference summary of Contract Number F 49620-80-C-0042.

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ABSTRACT

This addendum summarizes the remarks resulting from the

October 3, 1980 AIR FORCE STRUCTURES, STRUCTURAL DYNAMICS, AND

MATERIALS WORKSHOP under the chairmanship of Dr. V. B. Vankayya.

This workshop reflected summer research activity under a grant

from AIR FORCE OFFICE OF SCIENTIFIC RESEARCH of original papers

presented to the 21st AIAA/ASME/ASCE/AHS SDM Conference held in

Seattle, Washington May 12-14, 1980. Attached to this report are

two tapes which represent the full proceedings of the subject

workshop. Dr. David Allen's work at Texas A & M with Professor

Haisler has resulted in a grant from AFOSR to complete additional

experimental correlation.

Dr. V. B. Vankayya opened the session with some opening remarks and a welcome to the Air Force Wright Aeronautical Laboratory. Dr. Vankayya introduced Harry Harcrow who set the background of the workshop and introduced the student presentors. Fifty copies of the student papers were made available to the attendees.

This report shall discuss the highlights of each paper individually. Dr. Dorothy Reed was unable to attend the workshop; however, her paper was included with the proceedings.

DR. DAVID ALLEN - TEXAS A & M - "COMPUTATIONAL ASPECTS OF THE NON ISOTHERMAC CLASSICAL PLASTICITY"

Dr. Allen's original paper discussed thermal dynamic relevance of the theory with some comments on computational efficiency. The study activity included:

* Acceptability to remaining field equation

* Prediction of elastic/plastic and rate dependent material

* Computational examples of the theory

Questions/Comments/Remarks:

1. You have untilized a universal axial theory?

    Comment - A multi-axial theory along these lines are scheduled
                for presentation at the conference on "Computational
                Methods in Nonlinear Structural and Solid Mechanics"
                on 6-8 October 1980 with Professor Haisler. Phillips
                experimental work, Journal of Applied Mechanics December
                1973, supports the approach taken.

2. Using a Von Mises criteria, what type of power value/law do you use?

    Comment - We have used an exponential law, not a power law. It corresponds to a single Maxwell element with a non-linear spring and dash pot. The solution procedure is a first order Runge-Kutta. The non-linearity of the problem really restricts the size of the load step to assure convergence. It is an incremental virtual work problem.

3. What is the computational efficiency?

    Comment - Not very good at this time - however, some current investigations show promise. These include studies by Shampeni, Gear, and Henmarsh on a stiff equation solver package which uses a very sophisticated Runge-Kutta procedure. The problem now existing simply is the requirement for small load step intervals to assure convergence.

HAFSTEINN PALSSON - GEORGIA INSTITUTE OF TECHNOLOGY - "CLADDING ≠ STRUCTURE INTERACTION CASE STUDY FOR A HIGHRISE OFFICE TOWER"

Mr. Palsson's original paper discusses a numerical integration technique to define dynamic response of a tall vertical tower. The summer research study involved the application of this technique to a more complex structure to demonstrate associated dynamic interactions between structural elements. The study defined coupling effects of a cladding structure to a highrise office tower and their resulting dynamic interaction. The case study considered dynamic response of a 25 story office building to earthquake loadings and its

resulting dynamic response effect with the cladding structure. Five case studies were completed resulting in the following conclusions:

* Increase in structural frequencies due to cladding higher for non-composite than composite models.

* Significant increase in torsional frequencies which shows the effect of additional stiffness associated with cladding restraining twisting motion.

Questions/Comments/Remarks:

1. Any correlation of coupling between cladding and the forcing function used?

   Comment - This was not investigated.

2. Was any test data available for correlation with analysis?

   Comment - No, only ambrient levels. Georgia Institute of Technology is hoping to place shakers on several test buildings to define test data.

3. Can this be done?

   Comment - Yes, application of rectilinear shakers at Berkley has yielded adequate test data.

4. What model definition was used for the core?

   Comment - Core model was developed using Strull. Each member considered as interacting; however, wall effect was not considered as they were not load carrying members.

5. What is ratio of cladding mass to building mass which might effect frequency shifts?

Comment - The mass of the panels are included within the combined structural model and is not designed to carry any stiffness. Masses are lumped at floor connection points; therefore, no cladding forces.

Remark - Consideration should be given to modal loading and forcing function effects. Identify principal modal responses. This should show direct loading effect, and response, to cladding.

PAUL WIENHOLD - UNIVERSITY OF MARYLAND - "IN-SITU REFORMATION ELECTRON MICROSCOPY AND ITS APPLICATION TO FRACTURE MECHANICS RESEARCH"

Remark - Paul Weinhold's paper was an extension of his original paper on an extensive review of Electron Microscopy. The workshop paper served as a tutorial in the areas of Electron Microscopy and its applications to Fracture Mechanics research. The paper was followed by a tour of the AFWAL Electron Microscopy laboratory conducted by Dr. V. B. Vankayya.

**DR. DOROTHY REED - PRINCETON UNIVERSITY - "ARIMA REPRESENTATION OF LONGI-
TUDINAL, LATERAL, AND VERTICAL TURBULENCE SPECTRA"**

Dr. Reed's original paper formulated variable wind loading for hyperbolic cooling tower and the determination of its resulting dynamic response. The summer research expanded this formulation to include "Autoregressive Inter-grated Moving Average (ARIMA)" models.

Remark - An outstanding study reflecting a statistical mechanic method which more closely aligns with aerodynamic loading of buildings. Dr. Reed was unable to attend due to overseas committment.

**CINDY LEE WHITE - UNIVERSITY OF NEW HAMPSHIRE - "NASTRAN ANALYSIS OF THE
HYDROGEN AND OXYGEN POWER REACTANT STORAGE ASSEMBLY TANKS"**

Cindy White's original paper consisted of finite element modeling of a Shuttle Hydrogen PRSA tank and Signal Conditioner. The summer research study accomplished in association with the Beech Aircraft Corporation included model revision of the Hydrogen PRSA tank, modeling of an Oxygen PRSA tank, and genera-tion of tank frequencies and random response analyses.

Questions/Comments/Remarks:

1. How was mass modelled?

    Comment - Lumped masses was used at structural model attach points.
    This included lumped mass representation of the tank fluid.

2. How about sloshing?

    Comment - Fluid is filled under pressure; therefore, no sloshing.
    Responses actually reflect support attachment response.

3. In your correlations, are the displacements to scale?

Comment - No, they are not to scale. They are expanded to give

a better understanding of tank dynamic mode shapes.

Remark - Thanks were directed to Beech Aircraft Corporation for

their support of this activity. Additionally, Beech

Aircraft representatives were present and demonstrated

a full scale tank.

DONNA MARLOWE - UNIVERSITY OF ALABAMA - "ROCKET DISPLACEMENT ERRORS DUE
                                        TO THRUST DISALIGNMENT AND MASS UNBALANCE"

Donna Marlowe's original paper presented a method to define/assess

rocket path angle error due to pre-launch conditions. The summer research

utilized this technique to demonstrate rocket displacement errors and to

define stiffness optimization due to thrust misalignment and mass unbalance.

Questions/Comments/Remarks:

1. Are the transverse and longitudinal mass movements of inertia the

   same?

   Comment - Yes.

2. Does your rocket model reflect lumped or distributive mass?

   Comment - The rocket model is defined by a 11 point lumped mass model.

   Remark - Closer examination of Donna Marlowe's model and results

   indicates an error in the model.

   * As first question indicated, all mass movements of

   inertia are equal. This reflects a sphere and not a

   long slender model.

   * The results clearly indicate a classical precision

   motion.

CONCLUDING REMARKS:

The results of the first Air Force Methodology Conference was grati-
fying. The papers indicated a real understanding of associated engineering
principles and direct association with Air Force projects. Especially
gratifying was the realization that Dr. Allen's paper has resulted in a
Texas A & M grant for further experimental investigation.

The students were very grateful for the opportunity which was indicated
by their individual dedication to the tasks assigned. Comments received from
government, industry and universities universally praised the program. It is
disappointing that the program for 1981 had to be deleted. However, a propo-
sal will be submitted to AFOSR for 1982 funding.